

acquainted with the fact that the conformation of the skull and the position of the horns are quite enough to refute this, apart from the circumstance that the "bibovines" exhibit a specialised, and the bisons the primitive, type of coloration. Again, on p. 351, we are told that the ewes of the European mufion are invariably hornless.

Many remarks might be made with regard to the author's knowledge of extinct mammals, but perhaps it will suffice to indicate the extent of this by reference to a passage on p. 270, where we are calmly told that the Pliocene brachyodont *Rhinoceros etruscus* is identical with the Pleistocene hypsodont *R. leptorhinus*! If this be not enough, we may refer to p. 291, where it is suggested that the extinct Sedgwick's deer may be allied to the Oriental rusine group. Evidently the author does not know the difference between a "brow-tined" and a "fork-tined" antler, as, indeed, may be gathered from certain statements in regard to supposed roe-antlers later on in the work.

Passing on to the modern British fauna, a few lines may be devoted, in the first place, to the author's nomenclature. We are glad to see that, in the case of the generic names of the bats, modern usage is followed. We also note that in this group the author follows the "*Scomber-scomber*" usage, thus calling one species *Myotis myotis*. This being so, we fail to see why the otter and the badger are not respectively termed *Lutra lutra* and *Meles meles*, in place of *Lutra vulgaris* and *Meles taxus*. It is well to be consistent even in nomenclature! Still more surprised are we to find the weasel designated *Putorius vulgaris* on p. 161 and *P. nivalis* in the illustration on p. 163.

In the notice of Bechstein's bat, the author states that Mr. Millais took a specimen in 1902, whereas he should have written 1901, and he seems unaware that in the former year a note was published in regard to a specimen taken in 1886. In treating of the smaller rodents, the author has totally ignored the work of modern specialists. For instance, in the case of the squirrel, there is no mention of the fact that the British animal is regarded by specialists as a distinct form, which should be known as *Sciurus leucurus* if ranked as a species, or as *S. vulgaris leucurus* if a subspecies. Again, although mention is made of its seasonal colour-changes, the important fact that there is a curious difference in regard to the shedding of the coat on the body and on the tail is left unrecorded. Full reference should have been made to the paper by Mr. Thomas on this subject. Worse remains to be told in the case of the mice. In describing the wood-mouse, the author records and names five local races. Evidently, therefore, he considers such races worthy of notice. On turning, however, to the common mouse, we find no mention of the Hebridean wild form described by Captain Barrett-Hamilton as *Mus muralis* in 1899, while there is an equal lack of reference to the local forms of the harvest-mouse named by the same writer in that and the following year, and consequently the omission of the full title of the British race, namely *M. minutus minimus*. Neither is there any reference to the fact that the British short-tailed field-vole should be known as *M. agrestis neglectus*, as

pointed out by Captain Hamilton in 1896. Bearing in mind what has been said with regard to the local races of the wood-mouse, we can only attribute these omissions to ignorance on the part of the author—ignorance for which there is not the faintest shadow of an excuse in these days of up-to-date Zoological Records.

Other instances of this type might be quoted. We pass on to notice, however, that on p. 296 the author has actually reproduced figures of certain antlers from Scotland, published by Mr. Millais as those of the roe-buck, although it has long since been shown that the specimens in question are antlers of the South American pampas-deer which by some means had got into Scotland. Not content with this, Sir Harry proceeds to argue that these "fork-tined" antlers approximate to the red deer type. Evidently his lack of knowledge of antlers is on a par with that shown in connection with zoological literature.

After so much fault-finding, we are glad to record that the author calls the ancient wild ox by its proper name of aurochs, although, here again, if he would but take the trouble to read the descriptive label in the Natural History Museum he would find that his views as to the relationship of the white park cattle (which he will persist in calling wild) are far from being up to the level of those who know anything about the subject, and are acquainted with the meaning of albinism.

Among the most attractive features of the work are the coloured plates, all of which have been reproduced from original water-colour sketches by the author himself, whose artistic taste and powers are well known. Unlike the pictures of animals which we are accustomed to see in zoological publications, these sketches are designed from a decidedly artistic standpoint, and are admirably suited to a work of this nature. Many of the illustrations in black and white are also by the author, and are, for the most part, both life-like and artistic. We should, however, like to know what authority there is for depicting the long-eared bat (p. 105) with the ears depressed, while the wings are extended.

In conclusion, we may say that, had the author contented himself with writing a book of a less pretentious style, and ignored anatomy and subspecies, we should have had less cause to find fault with his effort. As it is, a thoroughly accurate, complete, and up-to-date book on British mammals has yet to be written.

R. L.

THERMODYNAMICS.

Treatise on Thermodynamics. By Dr. Max Planck. Translated by Alexander Ogg, M.A. Pp. xii+272. (London: Longmans, Green and Co., 1903.) Price 7s. 6d. net.

THE important part played by thermodynamics in modern physics, and especially in chemistry, is a sure guarantee that an English translation of Prof. Planck's work will receive a warm welcome in this country. It deals with the first and second laws, changes of state systems defined by any number of

variables, the phase law, gaseous systems, dissociation, and dilute solutions.

As is well known to specialists in thermodynamics, Prof. Planck, instead of using the thermodynamic potentials of the majority of writers, prefers to deduce the conditions of equilibrium from the study of the function

$$\frac{(\text{energy}) - (\text{temp.})(\text{entropy}) + (\text{pressure})(\text{vol.})}{-(\text{temperature})}$$

i.e. the ordinary thermodynamic potential corresponding to temperature and pressure as independent variables, divided by temperature and reversed in sign. While this function has not the advantage of being an exact analogue of the potential functions in statics, the differential coefficients of which with respect to the position-coordinates are equal to the corresponding generalised force-components, its introduction undoubtedly serves to bring the conditions of equilibrium and stability of thermodynamic systems into closer connection with the entropy properties. We should prefer to see the principle of degradation of energy instead of the entropy principle adopted as the basis of thermodynamics. This would obviate the introduction of Planck's function, the ordinary thermodynamic potentials taking its place. The compensating drawback is that the available energy of a system is not a definite measurable quantity, but is dependent on the surrounding media.

The method of introducing such notions as temperature and entropy cannot be regarded as satisfactory. We find in chapter i. the usual juggling with the terms "perfect gas" and "absolute temperature." Thus absolute temperature is defined in § 9 by the expansion of gases, while in § 24 these gases are shown to obey laws which are not rigorously consistent with this definition of temperature. The term "perfect gas" is introduced in a vague sort of way in this chapter, but without sufficiently definite statements being made as to what is a perfect gas and what is not. To define absolute temperature by means of a perfect gas and then define a perfect gas by means of its laws of expansion referred to absolute temperature is merely working round in a circle.

Moreover, the *entropy* of unit mass of a substance is defined, in the first instance, by the formula

$$\phi = c_v \log \theta + R/m \log v + \text{const.},$$

applicable to the case of a perfect gas. This definition is suggestive of the definitions of *pole* and *polar* given in many text-books, according to which "the line $xx' + yy' = c^2$ is called the polar of the point $x'y'$ with respect to the circle $x^2 + y^2 = c^2$." But while the effects of the latter definitions are made patent by the absurd answers sent up by a large proportion of examination candidates to pole and polar questions on (e.g.) a so-called "general conic," opportunities at present do not occur so frequently in this country of testing how an average student, after reading such a treatment, would "define entropy." To define a physical quantity in the first instance by means of its value in a particular case, when the definition is not valid in the more general case, is certain to be misleading, and no amount of subsequent discussion, such as Prof. Planck

admittedly gives, can set matters right. We have marked instances of the same thing in the old-fashioned treatment of electrostatics and magnetism, in which bodies were stated without reservation to attract one another according to the law of the inverse square, and when dielectrics were subsequently introduced there seemed something wrong about the whole theory which the writer of this review never cleared up until after his undergraduate days.

From this it will be seen that if Prof. Planck's treatise is no worse than many others on the same subject, it is in some essential points no better. It is a book which will be read with great interest by the physicist, generally in conjunction with other books on the same subject, but it is scarcely the book for an engineer to refer to for information on the nature of "entropy."

G. H. B.

GEOGRAPHY AS A SCIENCE.

The Teaching of Geography. By Prof. J. W. Gregory D.Sc., F.R.S. (Melbourne and London: Whitcombe and Tombs, Ltd.)

The Austral Geographies. Classes ii., iii., iv., v. and vi. Same Author and Publishers.

PROF. J. W. GREGORY is taking an active part in the promotion of sound geographical instruction in the land of his adoption. In a lecture recently published he sets forth the scope of geography and the way in which it should be applied to education. In a series of school-books he shows practically how he would do this for Australian children.

For Prof. Gregory geography is not a science, but a branch of knowledge which may be taught scientifically—its subject-matter is "description drawn from observation; it is not a search for underlying principles, nor a discovery of ultimate causes." In applying this descriptive knowledge to education Prof. Gregory points out that descriptions must glide into explanations and awaken interests which cannot be satisfied without understanding this world of ours. The geographer must not hesitate to borrow from literature, history, or science that which will make his appeal to his pupil's imaginations most stimulating. Prof. Gregory's scheme, as developed in the "Austral Geographies," is to begin with a plan of table, school-room, school, &c., leading to a map, directions, seasons, clouds, rivers, land forms (in the first stage these are definitions), a brief description of Victoria, and a few lines about other Australian States and the continents. In each succeeding book some sections of physiography are discussed, and are followed by a description of (a) Australasia in Class iii., (b) the continents ending with Australia in Class iv., (c) the British Empire in Class v., (d) Europe, U.S.A., Japan, Pacific Archipelagoes, and world trade routes in Class vi. Both the physiographical and the geographical parts are so planned that each year more advanced conceptions, as well as greater details, are given. The books, in the hands of a good teacher who applies the hints given in Prof. Gregory's lecture, should yield useful results, and teach the pupil much about land forms and climate and descriptive topography.